CLAIMS

1. A plasma processing system for processing a substrate, comprising:

a plasma processing chamber within which a plasma is both ignited and sustained for said processing, said plasma processing chamber having an upper end and a lower end, said plasma processing chamber contains a material that does not substantially react with reactive gas chemistries that are delivered into said plasma processing chamber;

a coupling window disposed at an upper end of said plasma processing chamber.

an RF antenna arrangement disposed above a plane defined by said substrate when said substrate is disposed within said plasma processing chamber for said processing;

an electromagnet arrangement disposed above said plane defined by said substrate, said electromagnet arrangement being configured so as to result in a radial variation in the controlled magnetic field within said plasma processing chamber in the region proximate said coupling window and antenna when at least one direct current is supplied to said electromagnet arrangement, said radial variation being effective to affect processing uniformity across said substrate;

a dc power supply coupled to said electromagnet arrangement, said dc power supply having a controller to vary a magnitude of said at least one direct current, thereby changing said radial variation in said controlled magnetic field within said plasma processing chamber in said region proximate said antenna to improve said processing uniformity across said substrate.

2. The plasma processing system of claim 1 wherein said plasma processing chamber includes an inner surface and at least the inner surface of the plasma

processing chamber is made of a material that does not substantially interact with reactive gas chemistries that are flown into said plasma processing chamber.

3. The plasma processing system of claim 2 wherein said material of said plasma processing chamber is selected from a group of materials consisting of silicon carbide, quartz, silicon, silicon dioxide, carbon, boron carbide, and boron nitride.

4. The plasma processing system of claim 1 wherein said plasma processing chamber is entirely made of a material that does not substantially interact with reactive gas chemistries that are delivered into the single chamber.

5. The plasma processing system of claim 4 wherein said material of said plasma processing chamber is selected from a group of materials consisting of silicon carbide, quartz, silicon, silicon dioxide, carbon, boron carbide, and boron nitride.

6. The plasma processing system of claim 1 wherein said material of said plasma processing chamber is silicon carbide.

7. The plasma processing system of claim 6 wherein the silicon carbide of said plasma processing chamber is selected from a group of materials consisting of Chemical Vapor Deposition (CVD), Slipcast Forming, hot-pressed and sintered, iso-statically-pressed and sintered formed silicon carbide.

8. The plasma processing system of claim 1 wherein the silicon carbide of said plasma processing chamber is Chemical Vapor Deposition (CVD) deposited silicon carbide.

9. The plasma processing system of claim 2 wherein said material of said plasma processing chamber is a coating of material.

10. The plasma processing system of claim 2 wherein said material of said plasma processing chamber is a coating of Silicon carbide.

11. The plasma processing system of claim 2 wherein material forming said inner surface of said plasma processing chamber is provided by a bonded assembly consisting of a suitable material bonded the chamber wall.

12. The plasma processing system of claim 11, wherein said bonded assembly is bonded with a electrically conductive or a thermally conductive adhesive.

13. The plasma processing system of claim 11, wherein said bonded assembly is configured to reliably form a significant part of the plasma ground.

14. The plasma processing system of claim 11, wherein said bonded assembly is comprised of several segments or tiles of said suitable material bonded to the chamber wall.

15. The plasma processing of claim 11, wherein said suitable material is Silicon carbide.

16. The plasma processing system of claim 2, wherein material forming said inner surface of said plasma processing chamber is a provided by a bonded assembly consisting of a suitable material bonded to a support said, support being attached to the chamber wall.

17. The plasma processing system of claim 16, wherein said bonded assembly is bonded with an electrically conductive or a thermally conductive adhesive.

18. The plasma processing system of claim 16, wherein said bonded assembly is configured to reliably form a significant part of plasma ground.

19. The plasma processing system of claim 16, wherein said bonded assembly is comprised of several segments or tiles.

20. The plasma processing system as recited in claim 16, wherein said suitable material is Silicon carbide.

21. The plasma processing system of claim 2 further comprising:

a substrate support configured to support said substrate during said processing, wherein said substrate support forming part of the inner surface of the reactor is made of a material that is more electrically resistant than that of the material of said plasma processing chamber.

22. The plasma processing system of claim 21 wherein said material of said substrate support is selected from a group of materials consisting of silicon carbide, quartz, silicon, silicon dioxide, carbon, boron carbide, boron nitride, and anodized aluminum.

23. The plasma processing system of claim 21 wherein said material of said substrate support is silicon carbide.

24. The plasma processing system of claim 1 wherein said substrate represents a semiconductor wafer.

25. The plasma processing system of claim 1 wherein said substrate represents a glass or plastic panel for use in flat panel display fabrication.

26. The plasma processing system of claim 1 wherein said processing includes etching said substrate.

27. A plasma processing system for processing a substrate, comprising:

a plasma processing chamber within which a plasma is both ignited and sustained for said processing, said plasma processing chamber having an upper end and a lower end, at least an inner surface of said plasma processing is made of a material which is selected from a group of materials consisting of silicon carbide, quartz, silicon, silicon dioxide, carbon, boron carbide, and boron nitride;

a coupling window disposed at an upper end of said plasma processing chamber.

an RF antenna arrangement disposed above a plane defined by said substrate when said substrate is disposed within said plasma processing chamber for said processing;

an electromagnet arrangement disposed above said plane defined by said substrate, said electromagnet arrangement being configured so as to result in a radial variation in the controlled magnetic field within said plasma processing chamber in the region proximate said coupling window and antenna when at least one direct current is supplied to said electromagnet arrangement, said radial variation being effective to affect processing uniformity across said substrate; and

a dc power supply coupled to said electromagnet arrangement, said dc power supply having a controller to vary a magnitude of said at least one direct current, thereby changing said radial variation in said controlled magnetic field within said

plasma processing chamber in said region proximate said antenna to improve said processing uniformity across said substrate.

28. A plasma processing system for processing a substrate, comprising:

a plasma processing chamber within which a plasma is both ignited and sustained for said processing, said plasma processing chamber having an upper end and a lower end, at least an inner surface of said plasma processing is made of silicon carbide;

a coupling window disposed at an upper end of said plasma processing chamber.

an RF antenna arrangement disposed above a plane defined by said substrate when said substrate is disposed within said plasma processing chamber for said processing;

an electromagnet arrangement disposed above said plane defined by said substrate, said electromagnet arrangement being configured so as to result in a radial variation in the controlled magnetic field within said plasma processing chamber in the region proximate said coupling window and antenna when at least one direct current is supplied to said electromagnet arrangement, said radial variation being effective to affect processing uniformity across said substrate; and

a dc power supply coupled to said electromagnet arrangement, said dc power supply having a controller to vary a magnitude of said at least one direct current, thereby changing said radial variation in said controlled magnetic field within said plasma processing chamber in said region proximate said antenna to improve said processing uniformity across said substrate.

29. The plasma processing system of claim 28 wherein said coupling window has at least one surface made of silicon carbide.

30. The plasma processing system of claim 28 wherein the silicon carbide of said plasma processing chamber is selected from a group of materials consisting of Chemical Vapor Deposition (CVD), Slipcast Forming, hot-pressed, sintered, iso-statically-pressed, and sintered formed silicon carbide.

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31. A method for controlling processing uniformity while processing a substrate using a plasma-enhanced process, comprising:

providing a plasma processing chamber having a single chamber, substantially azithmuthally symmetric configuration within which a plasma is both ignited and sustained during said processing of said substrate, said plasma processing chamber having no separate plasma generation chamber;

providing a coupling window disposed at an upper end of said plasma processing system;

providing an RF antenna arrangement disposed above a plane defined by said substrate when said substrate is disposed within said plasma processing chamber for said processing;

providing an electromagnet arrangement disposed above said plane defined by said substrate, said electromagnet arrangement being configured so as to result in a radial variation in the controlled magnetic field within said plasma processing chamber in the region proximate said coupling window and antenna when at least one direct current is supplied to said electromagnet arrangement, said radial variation being effective to affect processing uniformity across said substrate;

providing a dc power supply coupled to said electromagnet arrangement;

placing said substrate into said plasma processing chamber;

flowing reactant gases into said plasma processing chamber, said reactant gases include a combination of gases, wherein one or more gases of said combination of gases included in said reactant gases is a $C_x F_y H_z O_w$ gas, and wherein x, y, z, and w are positive integers though any of z, w, and y can be zero;

striking said plasma out of said reactant gases; and

changing said radial variation in said controlled magnetic field within said plasma processing chamber in said region proximate said antenna to improve said processing uniformity across said substrate.

32. The method of claim 31 wherein the reactant gases further include one or more gases selected from a group of gases consisting of O_2, N_2, CO, CO_2, SF_6, NF_3, NH_3, Cl_2 and HBr.

33. The method of claim 22 herein the reactant gases further include one or more gases selected from a group of gases consisting of He, Ne, Ar, Kr and Xe.

34. The method of claim 21 wherein the reactant gases further include one or more gases selected from a group of gases consisting of He, Ne, Ar, Kr and Xe.

35. The method of claim 21 wherein the reactant gases include a gas that is selected from a group of gases consisting of C_5F_8, C_4F_8, C_4F_6, C_3F_6, C_2F_6 and CF_4.

36. The method of claim 21 wherein the reactant gases include a gas that is selected from a group of gases consisting of C_2HF_8, C_2HF_5, CHF_3, $C_2H_2F_2$, $C_2H_2F_4$ and CH_2F_2.

37. The method of claim 21 wherein the reactant gases include a gas that is selected from a group of gases consisting of: ;

$C_5F_8 + CF_4 + CHF_3 + CH_2F_2$;

$C_4F_8 + CF_4 + CHF_3 + CH_2F_2$;

$C_4F_6 + CF_4 + CHF_3 + CH_2F_2$;

$C_3F_6 + CF_4 + CHF_3 + CH_2F_2$;

$C_2F_6 + CF_4 + CHF_3 + CH_2F_2$;

$C_2HF_5 + CF_4 + CHF_3 + CH_2F_2$;

$C_5F_8 + CF_4 + CHF_3 + C_2H_2F_4$;

$C_4F_8 + CF_4 + CHF_3 + C_2H_2F_4$;

$C_4F_6 + CF_4 + CHF_3 + C_2H_2F_4$;

$C_3F_6 + CF_4 + CHF_3 + C_2H_2F_4$;

$C_2F_6 + CF_4 + CHF_3 + C_2H_2F_4$;

$C_2HF_5 + CF_4 + CHF_3 + C_2H_2F_4$;

$C_5F_8 + CHF_3 + C_2HF_5 + CH_2F_2$;

$C_4F_8 + CHF_3 + C_2HF_5 + CH_2F_2$;

$C_4F_6 + CHF_3 + C_2HF_5 + CH_2F_2$;

$C_3F_6 + CHF_3 + C_2HF_5 + CH_2F_2$;

$C_2F_6 + CHF_3 + C_2HF_5 + CH_2F_2$; and

$CF_4 + CHF_3 + C_2HF_5 + CH_2F_2$.

38. The method of claim 37 wherein the reactant gases further include one or more gases selected from a group of gases consisting of O_2, N_2, CO, CO_2 and SF_6.

39. The method of claim 38, wherein the reactant gases further include one or more gases selected from a group of gases consisting of He, Ne, Ar, Kr and Xe.

40. The method of claim 37, wherein the reactant gases further include one or more gases selected from a group of gases consisting of O_2, N_2, CO, CO_2 NF_3, NH_3, Cl_2 or HBr and SF_6.

41. The method of claim 37, wherein the reactant gases further include one or more gases selected from a group of gases consisting of He, Ne, Ar, Kr and Xe.

42. The method of claim 31 wherein said plasma processing chamber includes an inner surface and at least the inner surface of the plasma processing chamber is made of a material that does not substantially interact with reactive gas chemistries that are flown into said plasma processing chamber.

43. The plasma processing system of claim 42 wherein said material of said plasma processing chamber is selected from a group of materials consisting of silicon carbide, quartz, silicon, silicon dioxide, carbon, boron carbide, and boron nitride

44. The method of claim 31, wherein said plasma processing chamber includes silicon carbide.

45. The method of claim 31 wherein said plasma processing chamber is made entirely of silicon carbide.

46. The plasma processing system of claim 1 wherein reactant gases are flown into said plasma processing chamber, said reactant gases including a combination of gases wherein one or more gases of said combination of gases included in said reactant gases is a $C_x F_y H_z O_w$ gas, and wherein x, y, z, and w are positive integers, and at least one of z and w can be zero, or at least one of y and w can be zero.

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47. The plasma processing system of claim 46 wherein said reactant gases further include one or more gases selected from a group of gases consisting of O_2, N_2, CO, CO_2 NF_3, NH_3, Cl_2, HBr and SF_6.

48. The method of claim 46 wherein said reactant gases further include one or more gases selected from a group of gases consisting of He, Ne, Ar, Kr and Xe.

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